RSVP RENEWABLES FOR SUSTAINABLE VILLAGE POWER

PROJECT BRIEF

Renewable Energy Electricity for Social and Economic Development in Rural Ghana

by Roger Taylor 12/97

Background

The Republic of Ghana is between four and twelve degrees north latitude, bordering the North Atlantic Ocean between Côte d'Ivoire to the west and Togo to the east. The climate is warm and comparatively dry along the southeast coast, hot and humid in the southwest, and hot and dry in the north. About 18 million people populate Ghana. Their average per capita income is approximately $400. Ghana has identified 4,221 village communities with a population above 500 inhabitants. As of 1991, only 478 of these communities had been electrified, all of them via grid extension. By December 1995, the number had grown to 904.

Ghana's electric power system is operated by two parastatal utilities: the Volta River Authority (VRA) and the Electricity Corporation of Ghana (ECG). The VRA is responsible for power generation and transmission at 161 kilowatt-amperes (KVA) and 225 KVA. The ECG is responsible for distributing power in the south while the Northern Electricity Department (NED), a subdivision of VRA, handles power distribution in the north. The VRA and the ECG report to the Ghanian Ministry of Mines and Energy.

The government of Ghana is committed to bringing electric service to every community of 500 or more people by the year 2020. The National Electrification Scheme (NES) is planned to proceed in six five-year phases from 1990 to 2020. It has been assumed that grid extension, with community participation under the Self-Help Electrification Program (SHEP), would be used to bring electricity to the more than 3000 villages still in need. This is a challenge and financially difficult for several reasons: the low density of rural populations, low income levels, the significant distances required for medium-voltage lines, and the costs of medium-voltage and low-voltage lines, transformers, and service drops. Most of the equipment is imported, and more than 90% of its cost is in foreign exchange. Also, SHEP requires that communities be within 20 km of a medium-voltage line, a prohibitive condition for many.

Even if the Ghanian NES meets its goals, many remote communities will still lack electricity. However, free-standing photovoltaic (PV) systems can provide valuable electric service to smaller and larger communities that would otherwise be electrified via grid extension. If population growth (3%/year) continues, by the year 2020 the population of Ghana will have doubled, presenting additional challenges for rural electrification schemes.

Project Objectives

The project goals are to facilitate the development of a national capacity, combining both private-sector and public-sector efforts; to use primarily renewable-energy-based technologies, especially PV and PV/diesel-hybrid power systems; and to provide sustainable rural electric power services. These technologies will serve in individual applications and centralized elec-trification of off-grid communities unsuitable for electrification via grid extension.

VRA/NED will own and operate the power systems and provide electric service to target villages on a fee-for-service basis. Rural communities will be expected to keep equipment from being abused or damaged. They will also be expected to invest "sweat equity" in the systems through labor and some capital contribuitons for installation of power poles and PV units. Because the government of Ghana subsidizes electricity prices, the government will cofinance the delivery of electricity services, while requiring a fee for service from the communities. There is some precedent (a PV battery charging project in northwestern Ghana sponsored by the Ministry of Mines and Energy [MOME]) in having rural communities pay for electricity services. The costs are comparable to current household expenses ($5 to $15/month) for candles, kerosene, dry cell batteries, auto batteries, and battery charging. Service costs will be determined in the project design, but the government is committed to cost recovery for electric service as part of economic restructuring and recent utility restructuring legislation.

Technical and economic performance data will be used to assess how pilot-scale renewable energy options might apply to much larger projects. The intent is to remove barriers to the introduction and widespread diffusion of renewable energy technologies for off-grid electricity in rural Ghana.

Project Description

Twelve villages in the Mamprusi East District and the village of Tenzug in Northern Ghana were selected for participation. Microgrids powered by PV/diesel-hybrid systems will be installed in three villages and free-standing PV units used in nine others. A community energy and socio-economic survey was initiated by MOME in collaboration with VRA/NED and the National Renewable Energy Laboratory (NREL) for the target region. The survey will help assess likely energy consumption patterns and community willingness and ability to pay for electricity. In addition, technical standards will be established and local operators and non-government organizations will be trained. The role of the parastatal VRA/NED will be critical in spurring the widespread use of the technologies.

Information on costs, training requirements, operational problems and solutions from previous installations will be used to establish practical technical standards for equipment and installation practices for systems in Ghana. Equipment specifications will be developed by the VRA/NED and MOME in collaboration with NREL and technical experts from the private sector.

Commercial equipment and appliances will be selected for simplicity, robustness, price, local availability and eventual local production. Particular attention will be paid to ease of maintenance in Ghana. Negotiations with suppliers will define the conditions for participating in joint ventures and technology transfer operations.

Energy services will respond to different levels of income and willingness and ability to pay for electricity. Services will include portable solar lanterns, fixed solar home systems, community services such as water pumping, and systems for refrigeration, sewing, carpentry, and grain grinding. Household PV systems will be installed in all twelve of the pilot communities. Lighting options will include high-efficiency compact fluorescent units.

Several villages will be assessed for possible siting of local minigrids powered by PV/diesel- hybrid units. Some will also have distributed PV systems for residential compounds and community functions located too far from the minigrid for hookup. Both technical and economic criteria will be used to determine the best power generation and distribution system designs.

Regional Operations and Maintenance

Providing highly reliable electricity services on a sustainable basis in rural areas requires local operations and maintenance capabilities. An operations and maintenance (O&M) center will be established near the pilot communities. Monitoring the hybrid power systems will permit diagnostics and early warning about potential problems. Quick-response maintenance and repair capabilities will be necessary to respond to technical problems with the hybrid power systems. The center will also support the PV solar home systems.

The O&M center will be established and staffed by trained VRA/NED technicians. A government-owned house will be renovated and equipped to support project implementation and post-project sustainability. The house is located in the town of Nakpanduri, about 30 km northwest of the center of the pilot region in the Mamprusi East District, and is less than 10 km from the nearest pilot community, Bimbagu.

The project action plan is now being prepared for in-country discussion and consensus building. Once the government of Ghana and the United Nations Development Program, with the Global Environment Facility, have approved the plan, implementation can begin.

NREL Contact

Web site: *http://www.rsvp.nrel.gov*

Roger Taylor
phone: (303) 384-7389
e-mail: roger_taylor@nrel.gov

Produced by the National Renewable Energy Laboratory, a U.S. Department of Energy national laboratory.

Printed with renewable source ink on paper containing at least 50% wastepaper, including 20% postconsumer waste.

NREL/FS-510-24194